

## SHORT COMMUNICATION

### REGURGITATION AMONG PENULTIMATE JUVENILES IN THE SUBSOCIAL SPIDER *ANELOSIMUS* CF. *STUDIOSUS* (THERIDIIDAE): ARE MALES FAVORED?

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**ABSTRACT.** Regurgitation from adult females towards juveniles is a well known phenomenon in social spiders. However, occasional observations in *Anelosimus* cf. *studiosus* from Uruguay showed the occurrence of food transfer also between large juveniles. We experimentally tested if well fed penultimate females were capable of regurgitating fluids to starved males, and if well fed penultimate males were capable of regurgitating fluids to starved females. Other isolated and starved penultimate males and females were used as controls. Starved males and females of the experimental groups significantly increased their body weight, whereas body weight decreased in controls. Males increased their weight more than females. We conclude that both well fed penultimate males and females can feed other starved subadults, but when given access to members of the opposite sex, males benefit than females. This bias in the regurgitation exchange among subadults could contribute to accelerate the maturation of males.

**Keywords:** Social spider, inter-juvenile regurgitation, *Anelosimus* cf. *studiosus*, Uruguay

Although some solitary species feed their spiderlings by regurgitation, this maternal behavior is considered the first step in the subsocial pathway to social life in spiders (Foelix 1996). Sociality evolved in a few families of spiders in which the juveniles depend on maternal regurgitation feeding (Kullmann 1972; Brach 1977; Buskirk 1981; Darchen & Delage-Darchen 1986; Foelix 1996). This phenomenon has been frequently described in the theridiid genus *Anelosimus* (Brach 1977; Christenson 1984; Vasconcellos-Neto et al. 1995), which contains both “non-territorial, permanent-social” species such as *A. eximius* Keyserling 1884, and “non-territorial, periodic-social” species such as *A. studiosus* (Hentz 1850), following Avilés (1997). However, inter-juvenile regurgitation in spiders has yet to be described. In laboratory conditions, we observed regurgitation from penultimate females to soliciting penultimate males in the subsocial *Anelosimus* cf. *studiosus* (reported in an abstract, Viera et al. 2001). In this paper, we indirectly tested the food transfer and sexual bias among penultimate juveniles by weighing individuals before and after they had access to well fed individuals. This analysis demonstrates an additional means of cooperation among spiders.

*Anelosimus* cf. *studiosus*, taxonomically close to *Anelosimus studiosus* (Agnarsson pers. comm.)

were collected as subadults in Montevideo, Uruguay (34°53'15"S, 56°08'33"W) during June 2001, from several nests located in low branches of a single tree. In the laboratory, they were reared in social groups (mixed from different nests) in large petri dishes (8.7 cm diameter and 1.4 cm height), until they reached the penultimate stage. They were fed various fly species (*Musca* sp. and *Drosophila* spp.) ad libitum.

Penultimate individuals were recognized by size and secondary sexual characters. For the experiment, spiders were confined in small petri dishes 3 cm diameter and 1 cm height, without water, and were weighed before the experiment and 24 h later at the end of the experiment. A scale of 0.1 mg of accuracy was used. For the experiments, one spider per dish was deprived of food for 6 days (starved spider). Four experimental groups were carried out simultaneously. In group A ( $n = 80$ ), a starved penultimate male was maintained with four satiated penultimate females. In group B ( $n = 40$ ), a starved penultimate female was maintained with four satiated penultimate males. In group C ( $n = 20$ ), a single starved penultimate male was maintained isolated, as a control for group A. In group D ( $n = 20$ ), a single starved penultimate female was maintained isolated, as a control for group B. When one or more individuals molted or died during the ex-

Table 1.—Spider weights in the four experimental groups (in mg) after a 24 hour period. Only starved individuals from groups A and B were weighed. Mean weight changes were calculated from the individual differences for each group; relative weight changes were calculated in relation to the initial weight.

Experimental groups	N	Initial weight Mean $\pm$ SD	Final weight Mean $\pm$ SD	Weight changes Mean $\pm$ SD	Relative weight changes (%) Mean $\pm$ SD
Group A	63	2.314 $\pm$ 0.439	2.451 $\pm$ 0.438	0.135 $\pm$ 0.118	6.164 $\pm$ 5.314
Group B	34	2.597 $\pm$ 0.521	2.682 $\pm$ 0.527	0.085 $\pm$ 0.110	3.505 $\pm$ 4.865
Group C	20	2.585 $\pm$ 0.574	2.540 $\pm$ 0.529	-0.045 $\pm$ 0.110	-1.392 $\pm$ 4.357
Group D	20	2.720 $\pm$ 0.884	2.690 $\pm$ 0.895	-0.030 $\pm$ 0.130	-1.198 $\pm$ 5.484

periment, that trial was discarded. Room temperature during the period of study averaged 18.7 °C ( $\pm$  2.5 SD; range 13.5–23.0). The non-paired Student *t*-test was used to compare difference in weight gain between groups. Voucher specimens were deposited in the Arachnological collection of the Faculty of Sciences, Montevideo, Uruguay.

Starved individuals of groups A and B increased their weight, whereas the weight decreased in the control groups C and D (Table 1). Mean weights changes showed statistically significant differences between males from groups A and C ( $t = 6.39$ ,  $P < 0.001$ ); between females from groups B and D ( $t = 3.32$ ,  $P < 0.01$ ); and between males from group A and females from group B ( $t = 2.49$ ,  $P < 0.02$ ); but not between the control groups ( $t = 0.39$ ,  $P > 0.60$ ). We estimated the mean weight of these regurgitations by adding the daily mean loss of weight per spider (caused by metabolic expenditure, defecation, water loss, silk generation) of the groups C and D plus the mean increment in weight observed in the starved spiders in A and B. Then, we estimated the weight of the regurgitations received by penultimate males of group A as 0.180 mg, which represents the 7.73 % of their initial weight, whereas females from group B gained 0.115 mg, representing 4.42 % of their initial weight.

The increment of body weight in starved penultimate males and females can only be attributed to the transfer of food from well fed conspecifics, because no other significant source of weight gain, food or water, was available in the experimental petri dishes. These gains in weight seem to be important, taking into account that they occur in only a 24 h period. The increment in group A, where one male was with 4 well fed females, was greater compared to B, where one female was with 4 well fed males in agreement with previous observations. Penultimate females could be better “donors” of regurgitations than penultimate males, or that males could be better “beggars” than the females.

We conclude that immature *A. cf. studiosus*, at least in the penultimate stage, share food among juveniles helping the starving individuals of both

sexes, and equalizing the food distribution in the colony. Regurgitation among juveniles could have an important role in the colony, because generally, the mother dies when juveniles are at the fourth or fifth stage (Viera et al. 2002; Viera et al. submitted). Food transfer in the field could be especially significant for males, considering that they received more food than females in this experiment and in the field, there are two females per male in this species (Viera et al. 2001; Viera et al. submitted). Regurgitation from subadult females could have an important role in determining the early maturation of males observed in this and other *Anelosimus* species, possibly reducing inbreeding (Viera et al. 2001; Bukowski & Avilés 2002). Furthermore, it could also provide competitive advantages for mating, as was pointed out by Henschel et al. (1995) and Schneider & Lubin (1997) for *Stegodyphus* spp. (Eresidae).

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